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TEA IN JAPAN.

Researches on the Manufacture of Various Kinds of Tea. Bulletin of the Imperial College of Agriculture and Dendrology. By Y. Kozai, Assistant in the Agricultural Chemical Laboratory. (Tokio, 1890.)

Y. KOZAI is a Japanese chemist who performed his researches under the control of Dr. Kellner, the Director of the Chemical Laboratory at Tokio. His paper includes the chemical constitution of tea, the effect of tea on mankind, the principal methods of manufacture employed in Japan, and the methods of preparing tea for consumption. These subjects are all treated mainly from the point of view of the analytic chemist. The author appears fairly well acquainted with what the German chemists have done in the matter of tea.

We need not abstract much of his account of the constitution and properties of tea, as it is largely taken from European sources. "The chief action of tea, after it has got into the blood, is to excite the nervous system; it thus harmonizes the mind, drives out drowsiness, and awakens thought, stops hunger, and cures repletion, refreshes the body, and prevents head-ache"—and (it might be added) if taken too strong keeps you awake half the night. As to its constitution, tea contains (besides the common plant-constituents) theine, a volatile oil, and tannin. Theine is a rank poison, in toxic doses causing convulsions and paralysis, in lethal doses death; but in small quantities is (like strychnine) a delicate tonic. Of the volatile oil, Y. Kozai can affirm little beyond its well-known exciting action upon the organs of taste and smell; nor is it easy to follow it analytically through the processes of manufacture; the hot steaming employed (at near boiling temperature) in the green-tea manufacture does not appear to diminish the volatile oil sensibly, though Y. Kozai intimates that preparing green tea by boiling does dissipate the aroma. As to the properties of tannin, it is an astringent remarkable for its strong affinity for the albuminoids; hence, if taken in excess, it may, by precipitating the ferments of the digestive fluids, cause indigestion.

The account of the chief Japanese methods of manufacture is of more interest and instruction to the European planter.

We may premise that there are two (main) kinds of tea, viz. black and green. In the manufacture of black tea there are four essential processes, viz. (1) withering; (2) rolling, (3) fermenting, (4) drying. In the manufacture of green tea, the fermenting is omitted, and in Japan (for some kinds of green) the rolling also.

For the manufacture of black tea there is no real difference between the Japanese method and that practised by English planters in Bengal. The fresh picked leaf (*i.e.* tips of the young shoots) must be first withered, or the petioles and leaves break under the rolling; the exposure of an hour or two in strong sun withers the leaf sufficiently; if there is no sun, the leaf must be withered by the aid of fire-heat. The rolling is done, even in Japan, by the aid usually of a box, and in Bengal often by steam-power (and very roughly). The juices are thus expressed, and the leaf given a "nice" twist, *i.e.* a twist pleasing to the fancy of the tea purchaser. What perhaps renders rolling so essential in the manufacture of black tea (for it is not esssential in the manufacture of green), is that it masses the leaf in a state conducing *without delay* to fermentation. Neither Y. Kozai nor the best Bengal authorities like to lose the juices more than can be helped. He also hazards the view that, by rolling, the juice is expressed from the cellular tissues of the leaves and impregnated upon their surface; thus is produced fine aroma, and the leaves are more easily infused. Fermentation is the most important point in the manufacture of black tea, and by it (*fide* Y. Kozai) the leaves lose their raw smell, and the tea acquires its fine flavour. The fermentation is really only carried a very little way: Y. Kozai says it should be allowed, in a temperature of 104° F., to proceed only for about an hour. He thinks the process is a true fermentation, because if permitted to run too far the tea acquires an acid taste. He thinks it probable that the ferment is caused by a living organism, but he adduces very slight ground for this opinion; and it has, in fact, been questioned whether there is any true fermentation in the process at all. But the English tea-makers are agreed with the Japanese in the importance of stopping the fermentation exactly at the proper point by drying the tea, which is usually done by placing it first in the sun and turning it over till it is fairly dry, and then thoroughly drying it by fire-heat.

The result of all the Bengal experience is that the black tea is at least as good when these four processes are done simply and rapidly, as when much labour and time are expended in complicating them. In the early days of tea manufacture by Anglo-Indians, great pains were taken to imitate with tedious minuteness the careful hand-processes (and repetitions of portions of the processes) as practised in China; but all planters now follow rapid short cuts to the finished tea.

The manufacture of green tea is nothing more than drying the leaf; it is so little practised in British India as to be of no commercial interest there, but Y. Kozai describes in detail three kinds of green tea manufactured in Japan.

(1) *Japanese* (not China) *green tea.* In this, the leaf is steamed in order to remove the raw flavour; it is then rolled and fire-dried, the two last processes being usually done together.

(2) *Chinese green tea.* In this, the leaf is roasted (while stirred with a stick) in an iron pan over a fire, then rolled a little, then roasted again; these processes being repeated even six or eight times, and the tea is then finally dried off.

(3) *Flat tea,* the highest class tea of all. For this tea, the shrubs are usually kept shaded for three weeks before picking, so that the leaf is partly etiolated. The choicest leaves are selected before the manufacture is commenced. They are steamed, but never rolled; nor, indeed, touched by hand at all, but carefully turned by the aid of a bamboo stick. After sufficient steaming they are simply dried.

The author finds by analysis that there is 30 per cent. more theine in etiolated leaves than in the leaves of the same plants grown in the light. He tried many experiments to test the chemical effect of the manufacturing

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processes. Among other tables given by him is the following; a quantity of leaf was divided into three portions, whereof one portion is A, another portion is manufactured into green tea B, the third portion is manufactured into black tea C. Y. Kozai analyzses A, B, C, and finds—

	A.	B.	C.
Crude protein	37·33	37·43	38·90
Crude fibre	10·44	10·06	10·07
Ethereal extract	6·49	5·52	5·82
Other nitrogen-free extract	27·86	31·43	35·39
Ash	4·97	4·92	4·93
Theine	3·30	3·20	3·30
Tannin	12·91	10·64	4·89

He remarks that the general result of the green-tea manufacture is merely to dry the leaf; the black-tea manufacture alters materially its chemical constitution. The principal change is the remarkable diminution of the tannin. He does not explain how this is brought about, nor is it easy to see how the incipient fermentation should affect the tannin.

The only teas exported to Europe from Japan are of low class; they are frequently "faced," and sometimes mixed with the leaves of various Japanese plants. Any plentiful leaf, not too unlike the leaf of tea, will do for this adulteration; the leaves actually employed are (Y. Kozai assures us) all harmless, and several contain tannin, but none of them any theine. As to the "facing," he says it can hardly be called adulteration; the quantity of Prussian blue employed to improve the appearance of green tea is (according to Y. Kozai) about 0·001 per cent. the weight of the tea, perfectly innocent, and pleasing to a purchaser.

The author concludes with an account of the different ways of taking tea in Japan, with some analyses of the prepared liquor.

(1) In the case of flat tea, or of the very finest quality of Japanese green tea, the tea is ground to fine powder, and the whole infusion drunk.

(2) In the case of superior (*i.e.* from the Japan point of view) tea, the leaves are infused for two minutes in water at 120°–150° F.

(3) In the case of a medium tea, the leaves are infused for one minute in boiling water.

(4) In the case of inferior tea, the leaves are boiled in water.

The object to be aimed at in the preparation is to get the largest possible quantity of theine without dissipating the aroma, and accompanied by only a moderate amount of tannin. Y. Kozai gives analyses to show that this is effected (in the case of superior teas) by the infusion in water at 120°–150° F. for two to five minutes. By superior teas, he understands teas worth five to seven shillings a pound in Japan. It is probable, therefore, that the highest class teas we ever have to deal with in England come under the medium teas of Y. Kozai, which require infusion in boiling water—for one minute at least. The majority of English people like a good deal of chicory with their coffee, and probably a majority also like a good deal of tannin with their tea; and to them the analyses and recommendations of the Japanese writer are of small importance.

The paper will be of more use as food for reflection to the Anglo-Indian planter than as direct instruction. The palate of the Englishman is as yet only very roughly educated in tea. There can be very few Englishmen who would greatly prefer the superior teas of Japan and China to the ordinary Kumaon or Ceylon tea; most persons used to drinking the latter would probably prefer it to the most expensive tea made—say China tea worth forty shillings per pound in China. The English planter in Bengal has a tea-garden of 200 acres (possibly still larger). His object is, by the aid of a steam-engine or other coarse help, to put his tea through—to keep his factory clear when he has a strong flush on. He has to carry the daily make through by the aid of uncivilized labourers and overseers. He must reduce every step of his manufacture to a routine; he must have no special tea separately and differently manufactured, and no current experiments. Few planters have made much profit by Pekoe; and the green tea hardly exists commercially in India. There are no doubt many Englishmen who, having not a plantation but (literally) a garden with some tea in it in India, have manufactured, not unsuccessfully so far as the flavour of the tea is concerned, green tea, Pekoe, &c., but this has been a fancy article for their own drinking or for presents, and has never been put in any quantity on the market. To plant successfully in India, the Englishman has to proceed on a broad scale; his large cost and high expected profit cannot be got out of the close superintendence of elaborate hand manufacture. Or, at least, it will be a long time before the public tea taste at home is sufficiently elevated to be willing to pay so large a price for such teas as would remunerate the English planter. For the present, the object of the planter must be to produce the maximum quantity of tea that the English grocer can sell at 1*s.* 6*d.* to 2*s.* 6*d.* a pound. Hence to planters the utility of the paper of Y. Kozai must be mainly future.

CATALOGUE OF BRITISH FOSSIL VERTEBRATES.

A Catalogue of British Fossil Vertebrata. By Arthur Smith Woodward and Charles Davies Sherborn. Pp. i.-xxxv., 1-396. (London: Dulau and Co., 1890.)

A WANT long felt by all students of the fossil Vertebrates of the British Islands has been supplied by the issue of the present volume, which, so far as we have been able to examine it, is noteworthy alike for the absence of misprints, the accuracy of the references, and the care which has been taken in the selection of the correct names for the various genera and species, as well as for the orthography of the names themselves. The last edition of the late Prof. John Morris's "Catalogue of British Fossils" was published as far back as 1854, and the advances made by this branch of palæontology since that date—and more especially during the last ten years—have naturally rendered that work quite out of date. It is true, indeed, that the first part of Mr. R. Etheridge's "Catalogue of the Fossils of the British Islands," and the British Museum Catalogues of Fossil Vertebrates, have afforded some assistance to students of this subject;

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